

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Previously Amended) An optical inspection system for inspecting the surface of a mask, reticle or semiconductor wafer, comprising:
 - a light source for emitting an incident light beam along an optical axis;
 - a first set of optical elements arranged for separating the incident light beam into a plurality of light beams, directing the plurality of light beams to intersect with the surface of the mask, reticle or semiconductor wafer, focusing the plurality of light beams to a plurality of scanning spots on the surface of the mask, reticle or semiconductor wafer; and
 - a light detector arrangement including individual light detectors that correspond to individual ones of a plurality of transmitted light beams caused by the intersection of the plurality of light beams with the surface of the mask, reticle or semiconductor wafer and by passing the plurality of light beams through the mask, reticle or semiconductor wafer, the light detectors being arranged for sensing the light intensity of the transmitted light.
2. (Previously Amended) The optical inspection system as recited in claim 24 wherein the first set of optical elements is arranged for separating the incident light beam into a plurality of spatially distinct light beams, which are offset and staggered relative to one another.
3. (Previously Amended) The optical inspection system as recited in claim 24 wherein each of the plurality of light beams has about the same light intensity.
4. (Original) The optical inspection system as recited in claim 2 wherein the plurality of spatially distinct light beams consist of a first light beam, a second light beam and a third light beam, all of which have about the same light intensity.
5. (Original) The optical inspection system as recited in claim 4, wherein the first light beam has about a same angular scan rate as the incident light beam and the second and third light beams have a different and non-linear scan rate relative to the incident light beam.

6. (Original) The optical inspection system as recited in claim 4 wherein the light detector arrangement includes a first light detector for detecting the first light beam and for generating a corresponding first scan signal, a second light detector for detecting the second light beam and for generating a corresponding second scan signal, and a third light detector for detecting the third light beam and for generating a corresponding third scan signal.

7. (Original) The optical inspection system as recited in claim 2 further comprising a second set of optical elements adapted for collecting either a plurality of reflected light beams or a plurality of transmitted light beams caused by the intersection of the plurality of light beams with the surface of the substrate, wherein the second set of optical elements is arranged for collecting the plurality of spatially distinct light beams, which have intersected with the surface of the substrate, and for directing individual ones of the collected light beams to individual light detectors of the light detector arrangement.

8. (Original) The optical inspection system as recited in claim 7, wherein the first light beam has about a same angular scan rate as the incident light beam and the second and third light beams have a different and non-linear scan rate relative to the incident light beam and wherein either the reflected light beams or transmitted light beams are collected at scan rates corresponding to the scan rates of the first, second, and third light beams.

9. (Previously Amended) The optical inspection system as recited in claim 24 wherein the first set of optical elements comprises a beam deflector disposed along the first optical axis, the beam deflector being arranged for deflecting the light beam such that the scanning spots are caused to sweep across the surface of the substrate in substantially one direction from a first point to a second point.

10. (Original) The optical inspection system as recited in claim 9 wherein the beam deflector comprises an acousto-optic device for causing the light beam to be deflected over a relatively small angle, the angle being at least one of the factors for determining the scan length of each of the scanning spots.

11. (Original) The optical inspection system as recited in claim 10 wherein the scan lengths of each of the scanning spots are combined to produce a scanning swath.

12. (Original) The optical inspection system as recited in claim 10 wherein the first set of optical elements comprises a beam separator disposed along the first optical axis, the beam separator being arranged for separating the light beam into the plurality of light beams.
13. (Original) The optical inspection system as recited in claim 12 wherein the beam separator is a diffraction grating.
14. (Original) The optical inspection system as recited in claim 13 wherein the diffraction grating is arranged for separating the light beam into a plurality of spatially distinct light beams, which when focused on the surface of the substrate produce a plurality of scanning spots which are offset and staggered relative to one another, and which cause a portion of the scan length of the scanning spots to overlap one another.
15. (Original) The optical inspection system as recited in claim 14 wherein the diffraction grating has a grating spacing and a grating rotation about the optical axis, and wherein each of the scanning spots has a specified overlap and separation that is controlled by the grating spacing and the grating rotation.
16. (Original) The optical inspection system as recited in claim 13 wherein the diffraction grating is selected from one of a transmission type grating or a reflective type grating.
17. (Original) The optical inspection system as recited in claim 16 wherein the transmission type grating is selected from one of a phase grating or an amplitude grating.
18. (Original) The optical inspection system as recited in claim 12 wherein the beam separator comprises a beam splitter cube.
19. (Previously Amended) The optical inspection system as recited in claim 24 wherein the first set of optical elements comprises a variable magnification subsystem disposed along the optical axis, the variable magnification subsystem being arranged for controlling the scanning spot size.
20. (Previously Amended) The optical inspection system as recited in claim 24 wherein the first set of optical elements comprises an objective lens disposed along the optical axis, the

objective lens being arranged for focusing the plurality of beams onto the surface of the substrate.

21. (Currently Amended) The optical inspection system as recited in claim 24 further comprising a stage for carrying the ~~substrate~~ reticle, mask, or semiconductor wafer such that the surface of the ~~substrate~~ reticle, mask, or semiconductor wafer moves in at least two directions within an inspection plane.

22. (Previously Amended) A method of inspecting a surface of a mask, reticle or semiconductor wafer for defects, comprising:

- planarly transporting the mask, reticle or semiconductor wafer in at least a linear and planar first direction;

- providing an initial light beam;

- deflecting the initial light beam in a second direction that is substantially perpendicular to the first direction;

- separating the deflecting initial light beam into a plurality of inspecting light beams that are made incident on the surface of the mask, reticle or semiconductor wafer, the inspecting light beams deflecting similarly to that of the initial light beam;

- focusing the plurality of inspecting light beams to a plurality of spatially distinct inspecting spots on the surface of the mask, reticle or semiconductor wafer, the spatially distinct inspecting spots scanning the surface of the mask, reticle or semiconductor wafer in accordance with the transporting mask, reticle or semiconductor wafer and the deflecting inspecting light beams;

- individually detecting the intensity of each of the plurality of inspecting light beams after their intersection with the surface of the mask, reticle or semiconductor wafer;

- generating a plurality of scan signals corresponding to the detected plurality of inspecting light beams; and

- comparing the scan signals with a predetermined reference signal to determine characteristics about the surface of the mask, reticle or semiconductor wafer.

23. (Previously Amended) An optical inspection system for inspecting a surface of a mask, reticle or semiconductor wafer for defects, comprising:

- a light source for emitting a light beam along an optical axis;

a diffraction grating disposed along the optical axis, the diffraction grating being arranged for separating the light beam into a plurality of light beams which form scanning spots on the surface of the mask, reticle or semiconductor wafer, each of the scanning spots having a specified overlap and separation with respect to one another that is controlled by the grating spacing and the rotation of the diffraction grating about the optical axis.

24. (Previously Amended) An optical inspection system for inspecting the surface of a reticle mask, or semiconductor wafer for defects along a linear scan path, the optical inspection system comprising:

- a light source for emitting an incident light beam along an optical axis;

- a first set of optical elements arranged for separating the incident light beam into a plurality of light beams, directing the plurality of light beams to intersect with the surface of the reticle mask, or semiconductor wafer, focusing the plurality of light beams to a plurality of scanning spots on the surface of the reticle mask, or semiconductor wafer, and sweeping the plurality of light beams so as to move the plurality of scanning spots along the surface of the reticle mask, or semiconductor wafer in a direction that traverses the direction of the linear scan path, the plurality of light beams working together to increase the speed of inspection; and

- a light detector arrangement including individual light detectors that correspond to individual ones of a plurality of reflected or transmitted light beams caused by the intersection of the plurality of light beams with the surface of the reticle mask, or semiconductor wafer, the light detectors being arranged for sensing the light intensity of either the reflected or transmitted light.

25. (Currently Amended) An optical inspection system capable of performing defect inspection on the surface of a reticle, mask or semiconductor wafer while the reticle, mask or semiconductor wafer is translated in a first direction via a stage, the optical inspection system, comprising:

- a light source for emitting a single light beam along an optical axis;

- a beam deflector for deflecting the single light beam in a second direction that is perpendicular to the first direction;

- a beam separator for separating the single light beam into a plurality of spatially distinct light beams, the plurality of spatially distinct light beams deflecting in a manner similar to the single light beam, the plurality of spatially distinct light beams maintaining a specified separation during deflection thereof, the beam separator being selected from a diffraction grating and a beam splitter cube;

optical elements for directing the plurality of spatially distinct light beams to intersect with the surface of the mask, reticle or semiconductor wafer, focusing the plurality of spatially distinct light beams to a plurality of spatially distinct scanning spots on the surface of the mask, reticle or semiconductor wafer and thereafter for collecting a plurality of reflected and transmitted light beams caused by the intersection of the plurality of spatially distinct light beams with the surface of the ~~substrate~~ mask, reticle or semiconductor wafer;

a transmitted light prism for receiving the transmitted light beams and for directing each of the plurality transmitted light beams to an individual light detector capable of sensing the light intensity of a single transmitted light beam; and

a reflected light prism for receiving the reflected light beams and for directing each of the plurality reflected light beams to an individual light detector capable of sensing the light intensity of a single reflected light beam.

26. (Previously Added) The optical inspection system as recited in claim 25 wherein the optical inspection system is configured to perform transmitted light inspection where the amount of light transmitted through the substrate is measured via the light detector arrangement.

27. (Previously Added) The optical inspection system as recited in claim 25 wherein the optical inspection system is configured to perform reflected light inspection where the amount of light reflected from the substrate is measured via the light detector arrangement.

28. (Previously Added) The optical inspection system as recited in claim 25 wherein the optical inspection system is configured to perform simultaneous transmitted and reflected light inspection where the amount of light transmitted through the substrate and the amount of light reflected from the substrate is measured via the light detector arrangement.

29-34. (Cancelled)

35. (Previously Amended) The method as recited in claim 22 wherein the defect inspection includes die to die inspection mode where two areas of the substrate having identical features are compared with respect to each other and any substantial discrepancy is flagged as a defect.

36. (Previously Amended) The method as recited in claim 22 wherein the defect inspection includes die to database inspection mode where the substrate is compared with an image stored in a database and any substantial discrepancy is flagged as a defect.

37. (Previously Amended) The method as recited in claim 22 wherein the defect inspection includes simultaneous reflected and transmitted inspection mode where the light reflected from the substrate is compared with the light transmitted through the substrate.

38. (Previously Amended) The optical inspection system as recited in claim 24 further including

a control system configured to construct a virtual image of the surface of the mask, reticle or semiconductor wafer based on the detected light and to compare the virtual image to a reference image so as to determine characteristics associated with the surface of the mask, reticle or semiconductor wafer.

39. (Previously Added) The system as recited in claim 38 wherein the reference image is stored in a database.

40. (Previously Added) The system as recited in claim 38 wherein the reference image is a previously constructed image.

41. (Previously Amended) An optical inspection system for inspecting a substrate, comprising:

a light source for emitting a light beam;

a first optical arrangement for separating the light beam into a plurality of spatially distinct light beams, the first optical arrangement including a diffraction grating or a beam splitter cube;

an objective lens for focusing the plurality of light beams to a plurality of scanning spots on the surface of the substrate and a telescope for varying the size of the scanning spots on the surface of the substrate;

a second optical arrangement for collecting either a plurality of reflected light beams or a plurality of transmitted light beams caused by the intersection of the plurality of light beams with the surface of the substrate, the second optical arrangement including a prism for directing individual ones of the plurality of reflected or transmitted beams to individual light detectors;

and

a light detector arrangement including individual light detectors that correspond to individual ones of the plurality of reflected or transmitted light beams, the light detectors being arranged for sensing the light intensity of either the reflected or transmitted light

42-43. (Cancelled)

44. (Previously Amended) The system as recited in claim 41 wherein the prism includes a facet for each one of the individual reflected or transmitted beams.

45. (Previously Amended) The system as recited in claim 41 wherein the second optical arrangement further includes a transmitted light lens for collecting the plurality of transmitted beams and an adjustable spherical aberration lens for directing the collected plurality of transmitted beams to the prism.

46. (Cancelled)

47. (Previously Added) An optical inspection system for inspecting the surface of a substrate, comprising:

a light source for emitting an incident light beam along an optical axis;

a first set of optical elements arranged for separating the incident light beam into a plurality of light beams, directing the plurality of light beams to intersect with the surface of the substrate, focusing the plurality of light beams to a plurality of scanning spots on the surface of the substrate, the first set of optical elements including a variable magnification subsystem disposed along the optical axis, the variable magnification subsystem being arranged for controlling the scanning spot size; and

a light detector arrangement including individual light detectors that correspond to individual ones of a plurality of transmitted light beams caused by the intersection of the plurality of light beams with the surface of the substrate and by passing the plurality of light beams through the substrate, the light detectors being arranged for sensing the light intensity of the transmitted light.

48. (Previously Added) The method as recited in claim 22 wherein the mask, reticle or semiconductor wafer is transported in the first direction as the beams are deflected in the second

direction.

49. (Previously Added) The optical inspection system as recited in claim 24 further including a stage for moving the mask, reticle or semiconductor wafer relative to the plurality of light beams, the scanning spots being configured to scan the surface of the mask, reticle or semiconductor wafer in order to find defects associated with the surface of the mask, reticle or semiconductor wafer when the mask, reticle or semiconductor wafer is moved relative to the plurality of light beams.

50. (Previously Added) The optical inspection system as recited in claim 48 wherein the mask, reticle or semiconductor wafer planarly moves back and forth in the first direction while being incremented in the second direction at the end of each traverse so that the scanning spots move along a serpentine path across a predetermined area of the mask, reticle or semiconductor wafer, the second direction being substantially perpendicular to the first direction.

51. (Previously Added) The optical inspection system as recited in claim 49 wherein the light beams are deflected in the second direction via the first set of optical components when the mask, reticle or semiconductor wafer moves in the first direction via the stage.

52. (Previously Added) The optical inspection system as recited in claim 24 wherein each of the scanning spots has a specified overlap and separation with respect to one another during use of the optical inspection system.

53. (Previously Added) The optical inspection system as recited in claim 25 wherein the optical elements include a variable magnification subsystem arranged for controlling the scanning spot size.

54. (Previously Added) The optical inspection system as recited in claim 53 wherein the beam deflector is an acousto-optic device, the beam separator is a diffraction grating, and the variable magnification subsystem includes a telescope.

55. (Previously Added) The optical inspection system as recited in claim 53 wherein the optical elements include a first transmitted lens and a spherical aberration correction lens for

helping focus the transmitted light beams onto the transmitted light prism.

56. (Previously Added) The optical inspection system as recited in claim 55 wherein the first transmitted lens, spherical aberration collection lens and the transmitted light prism are configured to move so as to adjust for the thickness of the reticle, mask or semiconductor wafer and the magnification level of the variable magnification subsystem.

57. (Previously Added) The optical inspection system as recited in claim 56 wherein the first transmitted lens and spherical aberration collection lens are configured to move along the optical axis and wherein the prism is configured to move orthogonal to the optical axis.

58. (Previously Added) The optical inspection system as recited in claim 57 further including a second transmitted light prism, the first transmitted light prism being configured for smaller scanning spot sizes and the second transmitted light prism being configured for larger scanning spot sizes.

59. (Previously Added) The optical inspection system as recited in claim 47 further including a beam deflector for deflecting the plurality of light beams and a beam separator for separating the incident light beam into a plurality of light beams.

60. (Currently Amended) ~~The optical inspection system as recited in claim 24~~ An optical inspection system for inspecting the surface of a reticle mask, or semiconductor wafer for defects along a linear scan path, the optical inspection system comprising:

a light source for emitting an incident light beam along an optical axis;

a first set of optical elements arranged for separating the incident light beam into a plurality of light beams, directing the plurality of light beams to intersect with the surface of the reticle mask, or semiconductor wafer, focusing the plurality of light beams to a plurality of scanning spots on the surface of the reticle mask, or semiconductor wafer, and sweeping the plurality of light beams so as to move the plurality of scanning spots along the surface of the reticle mask, or semiconductor wafer in a direction that traverses the direction of the linear scan path, the plurality of light beams working together to increase the speed of inspection; and

a light detector arrangement including individual light detectors that correspond to individual ones of a plurality of reflected or transmitted light beams caused by the intersection of the plurality of light beams with the surface of the reticle mask, or semiconductor wafer, the light

detectors being arranged for sensing the light intensity of either the reflected or transmitted light,
wherein when moved over an inspection length the scanning swath formed by the moving scanning spots produces an inspection area greater than would be otherwise achieved with non moving scanning spots.

61. (New) An optical inspection system for inspecting the surface of a reticle mask, or semiconductor wafer for defects along a linear scan path, the optical inspection system comprising:

a light source for emitting an incident light beam along an optical axis;

a first set of optical elements arranged for separating the incident light beam into a plurality of light beams, directing the plurality of light beams to intersect with the surface of the reticle mask, or semiconductor wafer, focusing the plurality of light beams to a plurality of scanning spots on the surface of the reticle mask, or semiconductor wafer, and sweeping the plurality of light beams so as to move the plurality of scanning spots along the surface of the reticle mask, or semiconductor wafer in a direction that traverses the direction of the linear scan path, the plurality of light beams working together to increase the speed of inspection;

a second set of optical elements adapted for collecting either a plurality of reflected light beams or a plurality of transmitted light beams caused by the intersection of the plurality of light beams with the surface of the substrate, wherein the second set of optical elements is arranged for collecting the plurality of spatially distinct light beams, which have intersected with the surface of the reticle, mask, or semiconductor wafer, and for directing individual ones of the collected light beams to individual light detectors of a light detector arrangement, the light detectors being arranged for sensing the light intensity of either the reflected or transmitted light,

wherein the plurality of light beams includes at least first, second and third light beams, the first light beam having about the same angular scan rate as the incident light beam and the second and third light beams having a different and non-linear scan rate relative to the incident light beam, and wherein either the reflected light beams or transmitted light beams are collected at scan rates corresponding to the scan rates of the first, second, and third light beams.